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ta used in the EIS was corrected
rs in this report. See the Industrial
Conservation and Cogeneration Working Paper for correct figures.

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ELECTRICITY CONSERVATION IN THE LUMBER AND WOOD PRODUCTS INDUSTRY

FINAL REPORT

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ELECTRICITY CONSERVATION IN THE LUMBER AND WOOD PRODUCTS INDUSTRY

FINAL REPORT

Richard Crane
Fredric Kropp
Carl Lian
Craig McDonald

Submitted to:

Energy Division
Department of Natural Resources and Conservation
32 South Ewing
Helena, Montana 59601

October 5, 1981

SYNERGIC RESOURCES CORPORATION
ONE BALA-CYNWYD PLAZA, SUITE 630 • BALA-CYNWYD, PA 19004

SRC
SYNERGIC RESOURCES CORPORATION
CRAIG McDONALD
DIRECTOR, NORTHWEST OFFICE

September 30, 1981

Mr. Paul Cartwright
Energy Department
Department of Natural Resources and Conservation
32 South Ewing
Helena, Mont. 59620

Dear Paul:

Enclosed are six copies of Electricity Conservation In The Lumber And Wood Products Industry - Revised Final Report, you will find that we have addressed your comments and incorporated your suggestions specifically.

- Documentation of the cost figures for the conservation approaches, including the conversion from hydraulic to friction barking (Appendix B).
- An additional paragraph dealing with the reuse of barking equipment (P III-2).
- A discussion of the operation and maintenance estimates (Appendix B).
- An expanded discussion of electric motor power factor controls (Chpater III).

We have reviewed the methodology and calculations used to develop the costs and savings for conversion from a hydraulic to friction barking system. The total savings were based upon the numbers and types of plants in the region and information obtained in the telephone interviews conducted in July 1981, using the methodology described in Chapter III and Appendix B (p. B-1). We believe these numbers are correct.

Please excuse the delay in getting the revisions to you, but it was necessary in order to get appropriate staff participation.

We have enjoyed working with you on this project and look forward to working with you in the future.

Sincerely,
SRC
Craig McDonald
Craig McDonald
Director PNW Office

4th & PIKE BUILDING, SUITE 820 • SEATTLE, WA. 98101 • 206-624-8508

PREFACE

In June and July 1981, the Pacific Northwest Office of Synergic Resources Corporation conducted a study of the conservation potential of electricity in the lumber and wood products industries served by the Applicant for the Kootenai River Hydroelectric Project. The results of that study are detailed in this report.

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CHAPTER I

INTRODUCTION

CHAPTER I

INTRODUCTION

PURPOSE

The purpose of this study is to perform an assessment of the electricity conservation potential in the lumber and wood products industry, in the service area of the proposed Kootenai Falls dam. Specifically, the study:

- Surveyed the major electricity users in the lumber and wood products industry to identify their energy use characteristics.
- Identified appropriate conservation measures (including cogeneration).
- Estimated annual electricity savings and relevant costs of implementation.
- Identified technically feasible cogeneration installations.
- Estimated installation costs and electricity production potential from cogeneration.
- Identified and assessed institutional barriers to implementation of conservation and cogeneration.

STUDY APPROACH

A multifaceted approach was employed to attain the study objectives. The major elements were:

- Interviews - A series of structured telephone interviews was conducted with the largest industrial electricity users in the service area of the proposed Kootenai Dam. Fifteen lumber firms, representing more than twenty operations, were contacted in July, 1981.

The purpose of the interviews was to ascertain information relative to: specific process characteristics; daily and seasonal operating schedules; conservation measures implemented or planned; the present use of waste wood; plans for expansion or process change; present or past experience with the on-site generation of electrical power; and perceived environmental and institutional constraints to cogeneration.

A summary of these interviews is presented in Appendix A: Interview Summary.

- Identification of Electricity Conservation Measures - Based on the results of the surveys and SRC's previous experience, conservation measures for the lumber and wood products industry were identified. The measures identified are: conversion of a hydraulic barking system to a friction barking system; sander abrasive replacement and saw and knife honing or replacement; electric motor power factor controls; cogeneration; installation of high efficiency lights; and programs to shut-off unneeded lights and equipment.

- Estimation of Potential Savings - Estimates of potential electricity savings attainable were developed for each of the techniques described above. Cost estimates, expressed in present discounted value and real annual payment, were also developed for each of the techniques.

  The conservation techniques, estimates of potential electricity savings and costs estimates are presented in Chapter III: Conservation Options.

- Development of Supply Schedules - The savings and costs for each conservation option were applied to the industrial usage patterns of the lumber and wood products industry in the proposed Kootenai Dam service area. A schedule of conservation that could be purchased--a supply schedule--was developed for the service area. This is described in Chapter IV: Study Findings.

- Analysis of Barriers to Cogeneration - Economic, institutional and environmental barriers which may hinder the development of cogeneration are identified and analyzed. Means for overcoming these barriers are discussed.

CHAPTER II

DESCRIPTION OF THE LUMBER AND WOOD PRODUCTS INDUSTRY

CHAPTER II

DESCRIPTION OF THE LUMBER AND WOOD PRODUCTS INDUSTRY

INTRODUCTION

Descriptions of typical plants for the different industrial sectors that comprise the lumber and wood products industry are presented in this chapter. Specifically, typical plants and process flow diagrams are described for:

- Sawmills and planing mills - SIC 2421.
- Softwood veneer and plywood industries - SIC 2436.
- Wood products not elsewhere classified - SIC 2499.

These descriptions were developed from the SRC current Survey of Pacific Northwest Industries.[1]

The industrial mix of the lumber and wood products firms in the service area are: ~~15~~ 14 sawmills, 3 planers, 1 post plant, 1 log mill, 1 veneer plant, 2 chippers, 1 stud mill and 2 chip loaders. In 1979, the lumber and wood products industry in the service area used almost ~~48~~ 53 million kilowatt hours of electricity. This is projected to increase to almost 78 million kilowatt hours in 1989.

Nationally, electricity purchases account for about 1.2 percent of total production costs for this industry group. Approximately 74 percent of the electricity used drives electric motors. The remaining is used

---

[1] Synergic Resources Corporation, Pacific Northwest Industrial Energy Use Data Base, Bala-Cynwyd, PA., July, 1981.

for space conditioning and lighting.[1]

SAWMILLS AND PLANING MILLS - SIC 2421

This industry comprises establishments primarily engaged in sawing rough lumber and timber from logs and bolts, or resawing cants and flitches into lumber, including box lumber and softwood cut stock; planing mills which are engaged primarily in producing surfaced lumber; and standard workings or patterns of lumber. This industry also includes establishments primarily engaged in sawing lath and railroad ties and in producing tobacco hogshead stock and snow fence lath.

There are three basic processes in this industry. First, logs are sawed to produce rough lumber, then the lumber is either kiln or air dried, and as the last step the lumber is planed. While some plants may perform only one of these functions, it is much more common for establishments in this SIC classification to start with logs as an input and produce dried and planed finished lumber. In some cases, plants may sell green (undried) as well as dried lumber. Plywood, particleboard, hardboard or specialty products may be produced as a sideline.

A process flow diagram for this industry is shown in Figure II-1. In processes 1 through 5 logs are washed, debarked and sawn to produce rough lumber. In process 7, the rough lumber is kiln or air dried. In processes 8 and 9, dried lumber is planed and trimmed to produce finished lumber. In process 6, wood and bark scraps go through a chipping operation to produce wood chips for sale or hogged bark and wood waste for fuel.

Kiln drying of lumber is by far the largest single use of thermal energy in a saw and planing mill. Generally, the kilns are heated with

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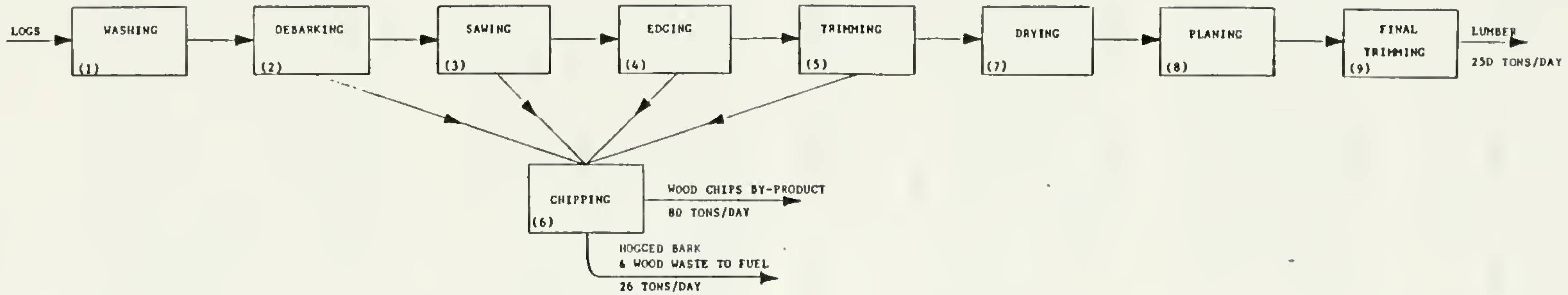
[1] Bonneville Power Administration, Technical Appendix: Draft Technical Assessment of the Potential for Conservation and End-Use Renewable Resources in the West Group Area 1980-2000, Portland, OR., April, 1981.

Figure II-1

SAWMILLS AND PLANING MILLS PROCESS FLOW DIAGRAM

(SIC 2421)



steam but may be direct fired. A small amount of thermal energy may be used to heat logs during debarking. The remaining processes require shaft power which may be provided by electric or steam driven equipment, but the use of electric drives is more common.

Saw and planing mills usually generate sufficient wood waste fuel to supply all thermal energy requirements. In addition to generating steam and/or hot water, some plants also generate electricity with wood fired boilers or cogenerate steam and electricity.

Energy use by a specific plant is mainly a function of the type of product (i.e. rough or finished lumber) and whether the lumber is air or kiln dried. To a lesser extent, the type of wood being processed and the moisture content of the logs and the time of year (i.e. frozen logs are more difficult to saw) have an impact on energy consumption.

SOFTWOOD VENEER AND PLYWOOD INDUSTRY - SIC 2436

This industry comprises establishments primarily engaged in the manufacture of commercial softwood veneer and plywood, from veneer produced in the same establishment or from purchased veneer. This industry is included in the 3-digit SIC classification 243 which also includes the 4-digit SIC codes 2431, millwork, 2434, kitchen cabinets, 2435, hardwood veneer and plywood, and 2439, structural wood members.

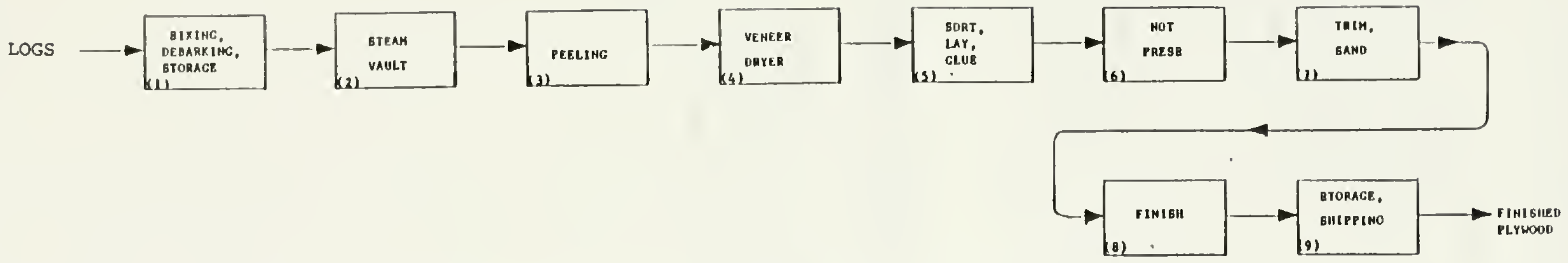
A process flow diagram is shown in Figure II-2. The production of plywood begins with the debarking and sizing of logs. The logs are then heated with steam or hot water to facilitate the peeling operation. In the peeling operation, one of several techniques is used to remove thin layers of wood from log. The veneer is then dried to prevent the growth of fungus and mildew on the green wood. Plywood is then produced by laying up and gluing several plies followed by pressing, trimming and finishing operations.

Electricity is used by debarking equipment, lathes, conveyors, fans,

Figure II-2

SOFTWOOD PLYWOOD AND VENEER INDUSTRY PROCESS FLOW DIAGRAM

(SIC 2436)



Source: Waterland, Viar and Associates.

sanding and sawing equipment and lights. Thermal energy in the form of hot water or steam is used to prepare logs for peeling, veneer drying, hot pressing and to a small extent for space heating.

Plywood plants may produce veneer on-site and/or may purchase veneer from another plant. Similarly, some of the veneer produced on-site may be sold. Plywood plants that produce veneer on-site also typically produce rough or finished lumber as a sideline. Logs may be processed directly to produce lumber, or lumber may be produced from the remnants of a log after it has been peeled. Plywood plants may also produce specialty products such as fiberboard. Plywood plants purchase electricity and generate nearly all required fuel on-site in the form of wood chips, shavings and sawdust. The only exception to this rule is veneer only plants, which dry their sheets using boilers fired by gas or oil.

WOOD PRODUCTS NOT ELSEWHERE CLASSIFIED - SIC 2499

For this area of Montana, the principal operations plants in this category are log and post mills. The process flow diagrams for these plants are similar to the sawmills diagram, with fewer trimming, sawing, and edging operations.

CHAPTER III

CONSERVATION OPTIONS

CHAPTER III

CONSERVATION OPTIONS

Synergic Resources Corporation was assisted by Waterland Vair Associates (WVA) in developing electricity conservation measures in the lumber and wood products industry. WVA conducted plant audits for specific firms in the Pacific Northwest and developed conservation estimates for typical plants. These estimates include both energy savings and associated costs. The methodology, costs and savings estimates for individual conservation measures are described in detail in the industrial conservation study being conducted for the Bonneville Power Administration.[1] The methodology and sources for estimating the energy and cost savings associated with the conservation methods are presented in Appendix B of this report.

CONVERSION OF A HYDRAULIC BARKING SYSTEM TO A FRICTION BARKING SYSTEM

Hydraulic barking is significantly more energy intensive than drum (friciton) barking. The primary energy requirement for hydraulic barking is electricity to drive the high pressure, high flow barking water pumps. The drum barkers require motors to drive the drums.

The drums can be operated wet or dry. If operated dry, the bark burned in the power boilers will have a lower moisture content. This represents an additional benefit.

Hydraulic and friction barking systems have different equipment requirements. With the exception of some log handling machinery, very little of the equipment used in hydraulic processing can be used in friction barking.

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[1] Synergic Resources Corporation, Analysis of Industrial Conservation Potential in the Pacific Northwest, Bala-Cynwyd, PA, September, 1981.

Conversion to friction barking can reduce energy requirements for barking by 20 percent. This results in the following reductions in total annual kwh used by the plant:

Sawmills	1.8 percent
Post and Log Mills	5.0 percent
Veneer Mills	4.9 percent

If the plant operates continuously, the cost for this conservation measure is equivalent to $0.099 per kwh saved in the first year. This is equivalent to a levelized cost of 9.10 mills/kwh using a real discount rate of 4.308 percent over a fifteen-year period. The levelized cost declines to 7.81 mills/kwh if the interest rate is subsidized.

SANDER ABRASIVE REPLACEMENT AND SAW AND KNIFE HONING OR REPLACEMENT

These maintenance items have a pronounced effect on the electric energy required per unit of production. Although these items are performed routinely, increased sander and saw maintenance can reduce energy use. It is conservatively estimated that a 10 percent increase in the frequency of abrasive element replacement and saw and knife sharpening can reduce the energy used by this equipment by 2.5 percent. On an annual basis, the following percent reductions in plant electricity use would be achieved:

Sawmills	1.8 percent
Planing Mills	2.5 percent
Post and Log Mills	1.6 percent
Veneer Plants	1.4 percent

The cost for this conservation option is equivalent to 34 mills/kwh saved in annual maintenance costs.

ELECTRIC MOTOR POWER FACTOR CONTROLS

The Nola power factor controller was developed at the NASA Marshall

Space Flight Center by Frank S. Nola for use with AC induction motors to reduce losses under light load conditions. The speed of an AC induction motor is nearly constant and is determined by the line frequency. The speed is essentially independent of the voltage or load. When the motor is heavily loaded, the current is nearly in phase with the voltage and the power factor is high (i.e., near 1.0). When the motor is lightly loaded, it develops less torque by allowing more lag between the voltage and current. This reduces the power factor while keeping the magnitude of the current essentially the same. Under light load conditions, an appreciable fraction of the current is dissipated in the supply lines and motor windings in the form of heat. This production of heat represents a loss and reduces motor efficiency.

The Nola controller monitors motor power factor. When the power factor decreases, indicating a light load condition, the controller reduces the voltage to the motor which causes a slight reduction in motor speed (less than 2%). Because the motor resistance is fixed, a reduction in voltage means a corresponding reduction in current. As a result, the motor acts as if it was more heavily loaded, the power factor is improved and because of the reduced voltage and current, there is a net savings of electric energy. Savings of up to 60 percent have been achieved for motors which are very lightly loaded.

Electric motors account for between 70 percent and 80 percent of the total electricity used by firms in the lumber and wood products industry. Many of these motors operate at or near their rated capacity. However, in any plant there will be a number of motors that frequently operate at half load or less. Motors are less efficient when operated at part load. Solid state "Nola" power factor controls can be used to reduce partload losses. It is estimated that power factor controls can reduce annual energy use by 1.5 percent.

The cost for this conservation measure is equivalent to $570 per kw of reduction in plant electric load (i.e. annual kwh saved/annual operating hours). This corresponds to a levelized cost of 20.95 mills/kwh for a plant operating 2500 hours and 10.48 mills/kwh for a plant operating

5000 hours, at a real discount rate of 4.308 percent over a fifteen-year period. If the interest rate is subsidized, the levelized costs are reduced to 17.98 mills/kwh and 8.99 mills/kwh, respectively.

COGENERATION

Cogeneration refers to the simultaneous production of electricity and thermal energy (i.e. steam). The coincidental production of electricity and thermal energy is more efficient than the production of electricity and thermal energy separately.

Cogeneration is potentially feasible where both electricity and thermal energy are required simultaneously. In the lumber and wood products industry this includes sawmills that use steam to kiln dry lumber and plywood, and veneer plants that use steam to dry green veneer. Cogeneration is also more feasible when an inexpensive source of energy is available. In the lumber and wood products industry this source is hog fuel and wood waste.

The fraction of total electricity use that can be supplied by a cogeneration system will vary from plant to plant. However, based on surveys of plants that do generate electricity on-site, it appears that cogeneration can supply at least 30 percent of total electricity requirements.

Typically a cogeneration system costs $1500 per kw of electrical capacity. Annual operating and maintenance costs are equal to approximately 5 percent of the capital costs. This corresponds to a levelized payment of 75.36 mills/kwh for a plant operating 2500 hours and 37.68 mills/kwh for a plant operating 5000 hours, at a real discount rate of 4.308 percent over a twenty year period.* If the interest rate is subsidized, the levelized costs are reduced to 68.93 mills/kwh and 34.46 mills/kwh, respectively.

---

* These costs may be high by approximately 5 mills per kwh because up to half of the taxes, insurance and other costs included in the operating and maintenance costs may be attributable to the process heat produced (i.e., these costs will be incurred even if there is no cogeneration).

INSTALLATION OF HIGH EFFICIENCY LIGHTS

It is estimated that lights account for 4 percent of annual electricity use. By replacing existing incandescent and fluorescent fixtures with high efficiency lamps and by eliminating unnecessary fixtures, it is estimated that lighting energy use can be decreased by one-third.

This represents a savings of 1.33 percent in annual electricity use. The initial investment cost is $1000 per average kw of lighting load saved (i.e., annual kwh savings/annual operating hours). Assuming that the bulb represents 20 percent of this cost and has a 5 year lifetime, and that the fixture represents 80 percent of the cost and has a 20 year lifetime, a levelized cost can be calculated. This corresponds to a levelized payment of 42.32 mills/kwh for a plant operating 2500 hours and 21.16 mills/kwh for a plant operating 5000 hours, at a real discount rate of 4.308 percent over a five-year period. If the interest rate is subsidized, the levelized costs are reduced to 36.32 mills/kwh and 18.16 mills/kwh, respectively.

INSTITUTE A STRICT CONTROL PROGRAM TO SHUT OFF UNNEEDED LIGHT AND EQUIPMENT

While this appears to be an obvious means for saving energy, it is usually not done unless it is made an integral part of comprehensive maintenance program and implementation is monitored and enforced. It is estimated that this maintenance procedure can reduce annual electricity use by 1.6 percent.

The cost of this program is 65 mills/kwh saved; assuming it requires one extra hour of labor for 300 days per year, at $7/hour.

CHAPTER IV

STUDY FINDINGS

CHAPTER IV

STUDY FINDINGS

OVERVIEW

The techniques for conserving energy in the lumber and wood products industry were described in Chapter III and are summarized in Table IV-1. The savings rates were applied to the 1979 energy usage of the major users in the lumber and wood products industry in the service area under study (energy use is shown in Table IV-2). This produced estimates of energy savings that could be purchased at different prices--in essence, a supply schedule.

The supply schedule, at unsubsidized rates, is presented in Table IV-3 and shown in Figure IV-1. The supply schedule, using the same subsidy rates as the Kootenai Falls Dam, is presented in Table IV-4 and shown in Figure IV-2.

The total electricity savings in the lumber and wood products industry, in 1979, would have been 19.5 million kwh, had all of the conservation measures been adopted. The savings by type of firm are shown in Table IV-5. The individual savings associated with each conservation measure are discussed below.

The largest savings would have been attributed to cogeneration--13.3 million kwh or 68.2 percent of the total. Cogeneration, however, is very expensive to purchase. The levelized cost to a mill operating 2500 hours a year is 75.36 mills/kwh and 37.68 mills/kwh for a plant operating 5000 hours. These costs are reduced to 68.93 and 34.46, respectively, if the purchases of conservation were subsidized at the same rate as the dam.

There are other barriers to cogeneration. First the technique is

Table IV-1: Summary of Conservation Option Costs

Conservation Measure	Electricity Savings (percent)	Capital Costs ($/kwh saved)	Operating Costs ($/kwh saved/yr)	Levelized Cost of Energy Saved (mills/kwh)	
				Unsubsidized	Subsized
Friction Barking					
Sawmills	1.8	.099	----(a)	9.10	7.81
Post and Logmills	5.0	.099	----	9.10	7.81
Veneer Mills	4.9	.099	----	9.10	7.81
Sander and Saw Maint.					
Sawmills	1.8	----	.034	34.00	34.00
Planing Mills	2.5	----	.034	34.00	34.00
Post and Log Mills	1.6	----	.034	34.00	34.00
Veneer Plants	1.4	----	.034	34.00	34.00
Electric Motor Power Factor Controller					
Operating 2500 hrs.	1.5	.228	----(a)	20.95	17.98
Operating 5000 hrs.	1.5	.114	----	10.48	8.99
Cogeneration					
Operating 2500 hrs.	30.0	.600	.030 (b)	75.36 (b)	68.93 (b)
Operating 5000 hrs.	30.0	.300	.015 (c)	37.68 (c)	34.46 (c)
High Efficiency Lighting					
Operating 2500 hrs.	1.33	.400	----(a)	42.32	36.32
Operating 5000 hrs.	1.33	.200	----	21.16	18.16
Equipment Shut-off	1.6	----	.065	65.00	65.00

(a) Operating costs are not significantly different with adoption of the measure.
(b) Costs may be 10 mills/kwh lower due to sharing of some operating costs with producing process heat.
(c) Costs may be 5 mills/kwh lower due to sharing of some operating costs with producing process hear.

Table IV-2: 1979 Energy Usage by Major Firms in the Lumber and Wood Products, in the Proposed Kootenai Falls Dam Area

TYPE OF FIRM	ENERGY SALES (thousands of kwh)	
Sawmills	47,212.3	
1 shift		7,754.2
2 shifts		44,116.9
hydraulic debarking		19,137.2
friction debarking		32,733.9
Planers	4,193.2	
1 shift		31.8
2 shifts		4,161.4
hydraulic debarking		none
friction or no debarking		4,193.2
Logs & Posts	479.5	
1 shift		232.3
2 shifts		247.2
hyraulic debarkers		-----
friction debarkers		479.5
Chippers	507.9	
1 shift		-----
2 shifts		460.5
hydraulic debarkers		441.8
friction debarkers		18.7
Veneer Plant	436.5	
1 shift		436.5
2 shifts		-----
hydraulic debarking		-----
friction debarking		436.5
TOTAL	52,829.4	

Table IV-3: Supply Schedule of Electricity Conservation, in 1979, Unsubsidized

Levelized Cost Per kwh (mills/kwh - 1981 dollars)	Conservation Technique	Electricity Conserved (thousands of kwh)	Cumulative Electricity Conserved (thousands of kwh)
9.10	B	344.5	344.5
10.48	C	664.9	1,009.4
20.95	C	127.5	1,136.9
21.16	F	589.5	1,726.4
34.00	D	977.5	2,703.9
37.68	E	13,298.0	16,001.9
42.32	F	113.1	16,115.0
65.00	A	845.3	16,960.3
75.36	E	2,550.8	19,511.1

A	Strict shut-off program
B	Conversion of hydraulic to friction barking
C	Electric motor power factor control
D	Sander abrasive replacement and saw and knife honing replacement
E	Cogeneration
F	Installation of high efficiency lights

Figure IV-1: Supply Schedule of Electricity Conservation, 1979, Unsubsidized (data from Table IV-3).

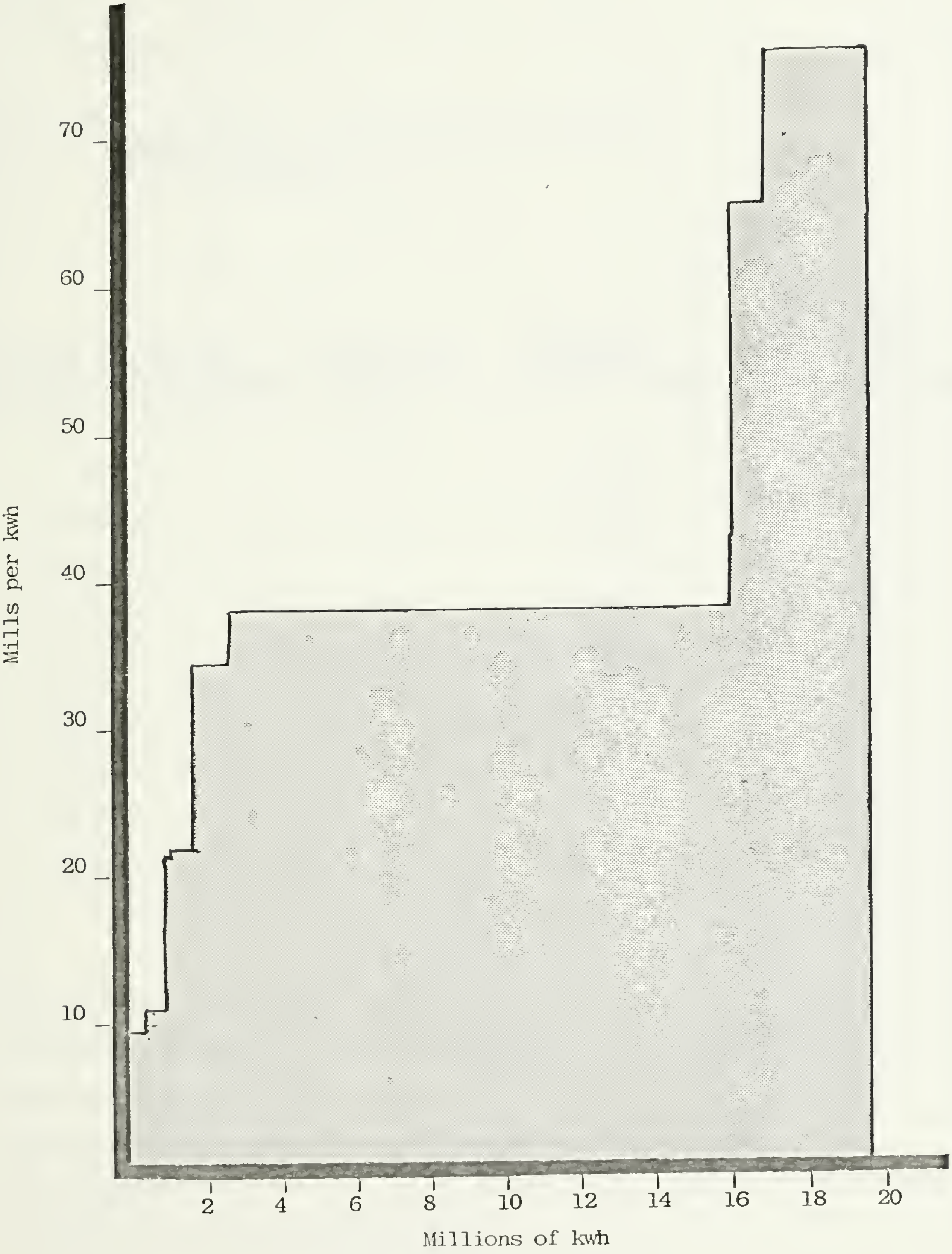

Table IV-4: Supply Schedule of Electricity Conservation, in 1979, Subsidized

Levelized Cost Per kwh (mills/kwh - 1981 dollars)	Conservation Technique	Electricity Conserved (thousands of kwh)	Cumulative Electricity Conserved (thousands of kwh)
7.81	B	344.5	344.5
8.99	C	664.9	1,009.4
17.98	C	127.5	1,136.9
18.16	F	589.5	1,726.4
34.00	D	977.5	2,703.9
34.46	E	13,298.0	16,001.9
36.32	F	113.1	16,115.0
65.00	A	845.3	16,960.3
68.93	E	2,550.8	19,511.1

A Strict shut-off program

B Conversion of hydraulic to friction barking

C Electric motor power factor control

D Sander abrasive replacement and saw and knife honing replacement

E Cogeneration

F Installation of high efficiency lights

Figure IV-2: Supply Schedule of Electricity Conservation, 1979, Subsidized (data from Table IV-4)

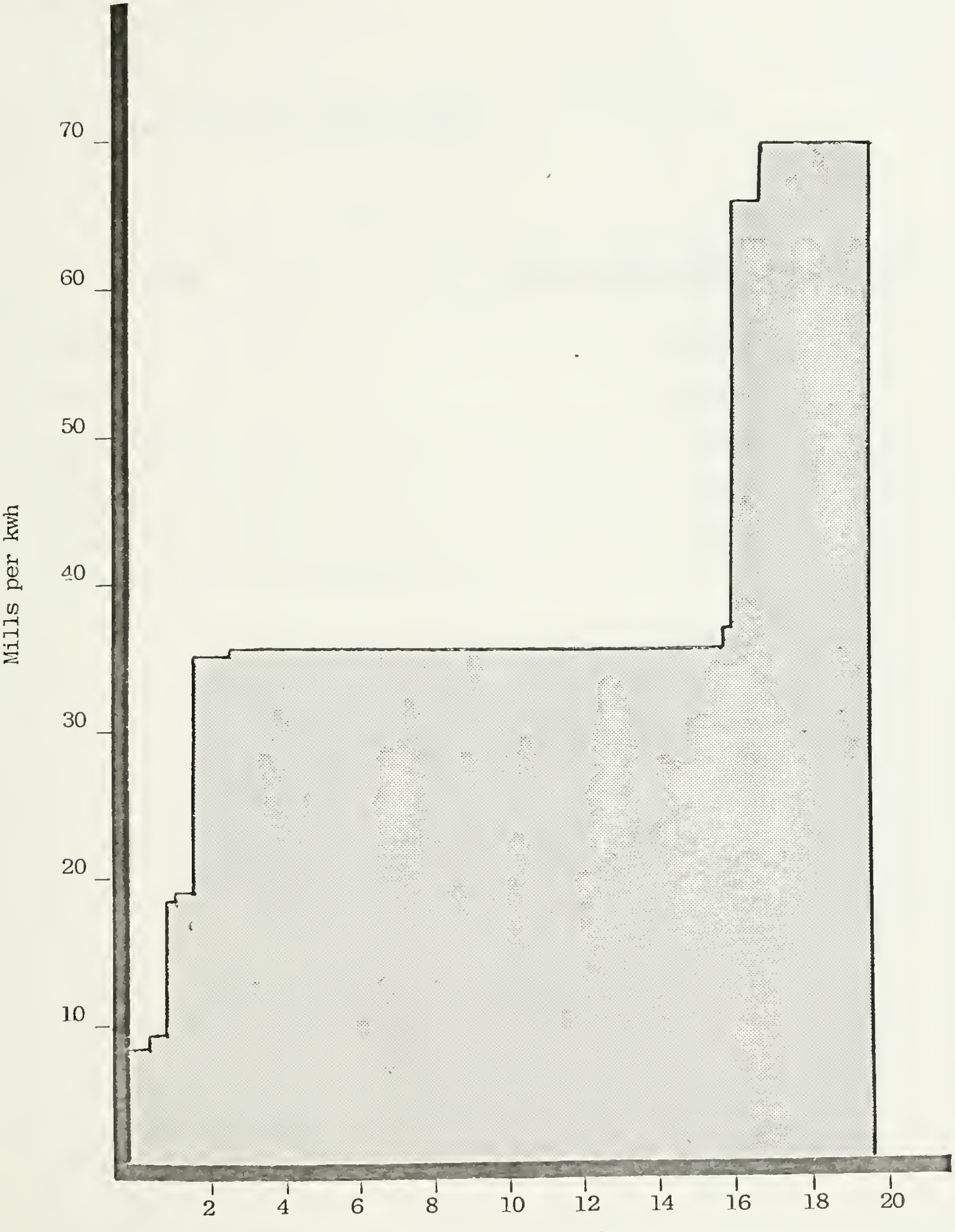

Table IV-5: Energy Savings by Type of Firm

FIRM	ENERGY SAVINGS (thousands of kwh)
Sawmill	17,449.4
Planer	1,548.4
Logs & Posts	172.9
Chippers	183.9
Veneer Plant	156.4
TOTAL	19,511.1

not applicable to all mills. The smaller mills that air-dry rather than kiln-dry wood, do not have the natural heat load needed to make cogeneration reasonable.[1] The interviews also identified perceptions that cogeneration could present problems with clean air regulations. In addition, the mills would lose a source of income by burning rather than selling the wood-chips and hog-fuel needed to cogenerate.

Notwithstanding, the largest barrier to cogeneration is the high initial capital costs. These costs would be an extreme burden and prohibitive for all but the largest mills. And, even the largest mills seemed reluctant to consider cogeneration given the current rates for purchased electricity.

Sander abrasive replacement and saw and knife honing or replacement represents the next highest conservation potential -- 1.0 million kwh or 5.1 percent of the total saved. This category, however, would produce only one-sixteenth the energy saved from cogeneration. The levelized cost is 34.0 mills/kwh.

Strict control programs to shut-off unneeded lights and equipment represent savings at a levelized cost of 65.0 mills/kwh. The savings, in 1979, would have been 845.3 thousand kwh or 4.3 percent of total.

Electric motor power factor controls offer another potential for savings. Total savings would have been 792.4 thousand kwh or 4.1 percent. The savings for a plant operating 2500 hours a year would have been 127.5 thousand kwh at a levelized cost of 20.95 mills/kwh (17.93, if subsidized). The savings for a plant operating 5000 hours would have been 664.9 thousand kwh at a levelized cost of 10.48 mills/kwh (8.99, if subsidized).

A total savings of 764.0 thousand kwh would have been realized from high efficiency lights. The cost of this program would be 42.32 mills/kwh for a plant operating 2500 hours and 21.16 mills/kwh for a

---

[1] These firms represent less than 5 percent of the industrial demand.

plant operating 5000 hours (36.32 and 18.16 mills/kwh, respectively, if subsidized).

There were only a few mills using hydraulic debarking techniques in the service area. Therefore, conversion from hydraulic to friction debarking would have only produced a savings of 244.5 thousand kwh in 1979.

ECONOMIC ANALYSIS ASSUMPTIONS

The levelized costs of energy saved were computed using the following assumptions:

- Inflation rate 10.25
- Interest rate 15 percent
- Subsidized interest rate of 12 percent
- Investment lifetimes: friciton barking - 15 years; electric motor controllers -- 15 years; cogeneration -- 15 years; bulbs for lighting -- 5 years; fixtures for lighting -- 20 years.

CHAPTER V

COGENERATION

CHAPTER V

COGENERATION

Cogeneration accounts for 68 percent of the estimated electricity conservation potential in the lumber and wood products industry. Prior to the 1950's cogeneration was widespread in this industry (1). However, as the price of electricity decreased, mills began using fossil fuels and wood residues to fire boilers and buying electricity. Today, relatively few mills cogenerate in the Northwest (2). Nevertheless, cogeneration represents an economical method of substantially reducing the electrical demand of lumber and wood product plants.

Investigations of cogeneration have identified a number of barriers to the widespread adoption of this technology (3, 4). These barriers can be catagorized as:

- Economic
- Institutional
- Environmental

Each of these categories of barriers are discussed using results from the interviews and previous studies.

ECONOMIC

The most cited reason for not cogenerating is the required capital investment. This may be just a reflection of the low cost of electricity. The firms interviewed purchase electricity at approximately 10 mills per kwh while the cost of electricity from cogeneration is estimated to be in the range of 35 to 80 mills per kwh (see Chapter IV). Clearly, no one will make a capital investment to supply a service which is currently available at substantially lower costs.

Provided that the marginal generation cost for the utility is lower than the cost of power from cogeneration, there are several actions that the utility could take to make cogeneration an attractive investment to the plant owner. These alternatives include:

1. Purchase the output from the cogeneration plant at the marginal cost of electricity and sell power to the plant at average cost.
2. Share construction costs with the plant owner so that the cost of power to the owner is equal to cost of power from the utility. For example, consider a plant which operates 5000 hours per year and purchases power from the utility at 15 mills. If the utility built the cogeneration facility, the plant owner would obtain 15 mill power if he paid just the operating costs.
3. Build and operate the cogeneration facility selling power to the plant at average cost.
4. Change rate structures so that the plant pays marginal electricity price for at least some of their consumption (ideally, the plant would see marginal costs for at least 30 percent of their consumption, or the portion which could be supplied by cogeneration).

Each of the above alternatives would improve the economics of cogeneration and substantially reduce the reluctance of plant owners to invest in cogeneration. Industrial firms may, however, be reluctant to invest in cogeneration (as required for alternatives 1 and 4, above) even though the economics are favorable. The reasons for this reluctance include:

1. Lack of available capital to invest.
2. Requirement for a higher rate of return than a utility typically uses.
3. Uncertainty about how long the utility would continue to purchase output at marginal costs and/or maintain a marginal cost element in the rate base.
4. Resistance to adding staff and management responsibilities for a function that is secondary to the activity of the manufacturing plant.

These would tend to suggest that alternatives which minimize capital investment requirements would be more advantageous.

On the otherhand, the industries are reluctant to turn over total control of an important element of their operation to an outsider. Also, utilities frequently prefer not to own the cogenerating facility. In a recent survey of 10 major utilities, 5 stated a preference for industry ownership of cogeneration facilities (6).

Thus, each alternative has some drawbacks which to some degree are related to institutional issues. In general, if there is return to be made on an investment in cogeneration, industry will make that investment despite institutional and environmental concerns (5).

INSTITUTIONAL

The three principal institutional barriers to the widespread adoption of cogeneration technology are: (1) uncertainty about regulatory status; (2) requirement for the utility or firm to undertake a new management and operational responsibility; and (3) lack of knowledge about cogeneration. To some degree, these barriers will be overcome once the economics of cogeneration become clearly favorable.

Firms have expressed a reluctance to make a cogeneration investment because they may be subject to regulation as an electrical producer. Such regulation would mean a loss of control over their own operations. On the other hand, changes in certain regulations may substantially alter rates at which utilities purchase output power. Federal legislation, notably PURPA, is designed to exempt most cogenerators from utility regulation and assure fair rates for the electricity produced (3). Most states are behind schedule in filing rates for cogenerated power. Now, the current adminstration is considering asking Congress to repeal PURPA. The regulatory environment is still a source of uncertainty.

The obvious action to overcome the regulatory uncertainty is to have the utility own and operate the cogenerating facility. Currently,

PURPA prohibits the utility from owning more than 50 percent of the cogenerating plant, although such limitations probably do not apply to public utilities.

Utilities have expressed concern about getting involved in cogeneration for a number of reasons, including (6):

- Reliability and maintenance of the facility and the effects on the utility and its customers.
- Safety of interconnection equipment and utility personnel.
- Loss of customers and erosion of the utility's base load.
- Availability of buy-back power from industrial cogenerators.
- Requirement for back-up capacity.
- Development of equitable rates from the viewpoints of the utility, its customer and the cogenerator.

In general, utilities favor cogeneration if there is no reliability safety question, if the facility would be a firm supplier of power at a rate which would save the utility money, if they could gain exemptions from the national energy act to burn oil or gas or get exemptions from emission standards to burn coal, and if there was no significant reduction of the utility's sales due to cogeneration (6).

Largely as a result of the above concerns, utilities in the Northwest have generally contracted for cogeneration output at non firm energy rates (7) which are considerably lower than firm energy rates. At least one utility has agreed to grant a capacity credit to cogenerators who will supply electricity during peak periods (8).

A major factor causing public utilities to limit cogeneration incentives in this region is that their marginal cost of power is the cost of purchasing additional power from BPA which is an average power cost (9). Thus, the utilities see marginal costs of approximately 27

mills per kwh, even though the BPA marginal electricity cost is in the range of 60 to 80 mills per kwh. Implementation of billing credits, penalty pricing, new rate structures and/or BPA purchase of cogenerated output will be required to provide the proper incentives to develop cogeneration.

ENVIRONMENTAL

Many of the firms surveyed were worried that air pollution regulations would prevent development of cogeneration. The cost estimates used in the analysis in Chapter IV included sufficient equipment to satisfy the Clean Air Act requirements. Clean Air Act and Oregon air requirements did not impose additional costs on a wood fired cogeneration facility being designed in Eugene, Oregon (10). In addition, most of the plants surveyed are already burning the wood wastes to generate process heat and are satisfying current air quality requirements. The environmental concerns expressed seem to be largely a result of a lack of information.

REFERENCES

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(6) Limaye, D. R., Industrial Cogeneration Case Studies, EM 1531 Synergic Resources Corp. for Electric Power Research Institute, Palo Alto, Ca., September, 1980.

(7) Randy Barcus, Washington Water Power, personal communication.

(8) Paul Ahern, Puget Sound Power and Light, personal communication.

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APPENDIX A

INTERVIEW SUMMARY

Appendix A:

INTERVIEW SUMMARY

The material described in this appendix represents a summary of key comments obtained from a series of telephone interviews conducted in July, 1981. The purpose of these interviews was to ascertain information concerning:

- Specific process characteristics
- Daily and seasonal operating schedules
- Conservation measures implemented or planned
- The present use of waste wood
- Plans for expansion or process change
- Present or past experience with the on-site generation of electrical power, that is, cogeneration
- Perceived environmental and institutional constraints to cogeneration

Only key comments are presented. Because of the inherent nature of telephone interviews, the information obatined was not uniform across respondents. The respondents familiarity with different subjects and their willingness to discuss them also varied among the interviews. As a group, the respondents were both knowledgable and cooperative. Some of the comments are presented in the colloquail interview style.

PYRAMID LUMBER

Served by Missoula Power, Pyramid has seperate accounts for its sawmill, post plant, and lumber planer. Pyramid uses a friction debarking process, and steam-dries timber in kilns powered by bark burning boilers. Pyramid does not consider cogeneration as economically worthwhile at the present time.

Pyramid employs 100 workers in two shifts. About 160,000 board feet is produced daily, with little seasonal variation. Due to the weak lumber market, output has been below normal recently. Pyramids rapidly rising demand for electricity from 1975 to 1978 also appears to have slowed down.

In addition to lumber, Pyramid produces (daily): 6 truckloads of chips, 3 truckloads of sawdust, 3 truckloads of shavings, and 5 truckloads of bark. Long-term (3 year) contracts are in force for the sale of chips, sawdust, and shavings. No long-term contract exists for the sale of bark. Note that if Pyramid installs a larger bark burning boiler, as planned, its sale of bark will be reduced (they currently sell about 2/3 of the bark produced).

Pyramid has already installed the thinnest sawblades available, and plans to install new, more efficient motors when market conditions permit.

AMERICAN TIMBER

Served by the Lincoln Co-op, American Timber produces 2 x 4 studs and wood chips. Friction debarking is used, and timber is dried with steam in a bark-burning boiler. Although cogeneration has not been implemented, the bark supply has been more than adaquate for the plant's needs.

American Timber operates 2 shifts, with 25 workers per shift. About 300,000 board feet is produced daily. Output does not vary seasonally, and electricity use is unusually stable throughout the year. American Timber also produces 24 truckloads (15 units per truck) of wood chips daily. The chips are sold under a long-term contract.

Expansion plans include the opening of a plywood plant. When the plywood plant is finished, 1 shift will operate at the stud plant and 2 shifts will operate the plywood plant, increasing employment to 100. Energy consumption will also continue its upward trend from an average

monthly billing demand of 976 kw in 1975 to 1164.8 kw in 1979 to an anitcipated 1355 kw in 1984 and 1550 kw in 1989.

Thinner saw blades have been installed to reduce electricity consumption per unit output. No changes have been made to improve motor efficiency. Motors include 20 - 5 hp, 20 - 7½ hp, 6 between 7½ and 100 hp, 2 - 100 hp, and 2 - 200 hp motors.

OWNES & HURST

Owens & Hurst is a well-established 2 x 4 studmill served by the Lincoln Electric Co-op. Logs are debarked by a friction process and timber is air-dried. Cogeneration has not been considered.

Owens & Hurst currently employs 35 workers in 2 shifts. Employment varies between 30 and 50 workers. The daily production of 2 x 4 studs is 100,000 board feet. In addition to lumber, Owens & Hurst sells 70 units of wood chips per day under a long-term contract.

Output and electric use are fairly constant throughout the year. No significant expansion is planned and electricity use is predicted to rise slowly from the 1979 level of 155 kw (average monthly billing demand).

The plant has installed thinner saw blades. If current motors need replacement, more efficient motors will be installed. No plans exist to improve the performance of current motors, which range in size from 5 to 200 hp. Log scanners are not seen as an energy conserving device.

KSANKA

Ksanka operates at four locations in western Montana and two locations in eastern Washington. All the Ksanka plants listed below use hydraulic debarking and dry timber in bark-burning kilns. The company is aware of cogeneration technology, but views the initial capital cost as being too high relative to the potential return. In particular, Ksanka does not believe cogenerating electricity by burning wood waste is feasible at the

present time. All of the plants sell wood chips under long-term contracts.

Specific information on the individual Ksanka plants operating in Western Montana includes the following:

- Pablo Plant: A sawmill and studmill producing 210,000 board feet lumber a day and 2,000 units wood chips monthly. The mill operates at 2 shifts.
- Fortune Plant: A sawmill producing 100,000 board feet lumber a day and 1,100 units of wood chips a month. This is served by the Lincoln Co-op and operates at 2 shifts.

Total employment at all of the 5 Ksanka plants is 1,700 and all the above plants operate year round. The plants have fairly stable month-to-month energy consumption. The plants have implemented some measures to increase output per unit of energy input - log scanners and/or thinner saw blades; however, no changes are anticipated in plant motors. The plants vary considerably in age and motor efficiency varies among plants.

STOLTZ & CONNER LUMBER CO.

Stoltz & Conner have seperate accounts with Ravalli for its chipper, planer, and sawmill. Hydraulic debarking is used in the sawmill and friction debarking is used in the studmill. The planer does not have a debarker. Timber is dried in a kiln using #6 fuel oil. If lumber market conditions permit, a hog fuel burning boiler will be installed by 1982. Cogeneration is not considered feasible due to the technological changes required for a relatively small plant and the low price paid for cogenerated electricity.

The plant employs 90 people, of whom 75 work in the mill area. The 2 shifts produce 100,000 board feet per day, or 25,000,000 board feet annually. Lumber output is fairly constant throughout the year, and electricity demand appears to vary about 30% during each year. Total electric use fell slightly in 1979.

In addition to lumber, Stoltz & Conner produces 28,000 units of residue annually. This residue includes 16,000 units of hog fuel, 9,200 units of

wood chips, and 2,700 units of shavings. The chips are sold under a 3-year contract. Hog fuel sales will fall considerably if the boiler is installed.

Due to weak timber market conditions, Stoltz & Conner has no major expansion plans. Stoltz & Conner does have a continuing efficiency program; improvements have been made in sawblades and optical log scanners are "down the road". Many of the motors used in the plant are unusually old. These older motors are considered by Stoltz & Conner to be more efficient than most medium-age motors and "as efficient as anything on the market today". Motor sizes vary from 5 to 200 hp, with clusters in the 5 - 15 hp, 75 - 100 hp, and 200 hp ranges.

S & W

S & W has separate accounts for its chipper and sawmill with Ravalli. The plant burned in 1976, and has been only partially rebuilt. Logs are debarked by a friction process. Timber is dried in kilns powered by wood waste. No plans for cogeneration are being considered. Major obstacles to cogeneration appear to be the expenditures necessitated by the 1976 fire.

S & W recently cut back from 2 shifts to 1 due to the high cost of input logs. Employing 30 workers, the plant produces 70,000 to 80,000 board feet of 2 x 4 studs per shift (as a result of the 1976 fire, only 2 x 4's are produced). Plant output does not vary seasonally, and electricity use appears to vary by only 30% annually.

In addition to 2 x 4 studs, S & W produces 8 truckloads of wood chips a day (12 units per truckload). Chips are sold under a long-term contract.

Since the 1976 fire, output and electricity use have risen significantly each year. Due to poor market conditions, however, no major expansion is underway. An improvement in lumber market conditions would probably cause significant increases in output and energy consumption, as rebuilding from the 1976 fire is not finished.

S & W has installed a log scanner and reduced sawblade width to reduce energy consumption per unit output. No changes in motors are currently anticipated. Motor sizes range from 2 to 200 hp, and the plant includes four 125 hp motors and two 100 hp motors.

FLATHEAD LUMBER

Served by the Flathead Project Power System, Flathead Lumber recently changed ownership. Logs are debarked using a friction process, and timber is dried in kilns powered by wood waste. Flathead Lumber is aware of the benefits of cogeneration, but it has not been implemented due to the initial set-up cost and perceived technological problems with the heat transfer system.

Flathead has 113 employees, and operates 2 shifts, 4 days a week in part of the mill, producing 110,000 to 118,000 board feet of lumber daily. The plant also produces 3 to 3¼ dry weight base tons of wood chips an hour, 16 hours a day, 4 days a week. These chips are sold without any long-term contracts. The respondent stated that the plant is unable to sell the hog fuel not burned in its own kilns because of air quaility control regulation.

Since the plant is already operating only 4 days a week with only ½ capacity, expansion is currently not considered. As a result, energy use is not expected to rise significantly above the 1979 peak level of 1480 kw. An attempt has been made to improve the electric consumption per unit output ratio by installing thinner saw blades. No changes have been made in the motors. The plant operates 5, 7½, 15 and 200 hp motors.

PLUM CREEK LUMBER CO.

A subsidiary of the Burlington Northern Railroad, Plum Creek is the largest user of electricity served by FIP. Logs are debarked in a hydraulic process. Lumber is steam-dried in kilns powered by a wood-waste burning boiler. Cogeneration is not considered economical at the present time.

Plum Creek employs 170 workers, and produces 50 to 60 million board feet of lumber annually. Output is constant throughout the year. Wood waste not burned in kilns is sold under a long-term contract.

Despite the depressed lumber market, Plum Creek's electricity consumption fell only 7.5 percent from 1979 to 1980. This relatively strong performance during industry recession may be due to Plum Creek's network of sales outlets in a broad area of the United States. In fact, Plum Creek's peak kw electricity useage has remained between 1950 kw and 2175 kw in every year since 1970 except 1977 (when the figure rose to 2400 kw).

The respondent terminated the interview at this point.

YAAK RIVER LUMBER CO.

Yaak River Lumber Co. is a small sawmill caught in transition. Currently, it produces green, rough-cut lumber and all waste products are burned. Future plans include the installation of a chipper.

Currently logs are debarked via a ring debarker (mechanical). As the lumber is sold green it is air dried. A kiln is planned for later use.

After installation of the chipper the intention is to sell the wood chips, hog fuel, hammer hog and fuel product. Yaak River is beginning their own Energy Development Program and is looking at own-power generation. It is felt that electricity use will remain constant and current plant capacity is sufficient and will remain unchanged.

Yaak River produces 40 - 50,000 board feet daily and employs 16 - 17 people. It is a year round operation with one shift daily, however, two shifts are contemplated.

Current motor distribution is: 2 - 150 hp; 1 - 100 hp; 1 - 30 hp; 1 - 25 hp; 5 misc. (1, 2, 3 hp).

BRAND S

Brand S is a moderate sized saw mill that debarks its log using mechanical debarking process. Lumber is dried with kiln heated by a steam boiler, fired by sawdust and waste products. The mill has a chipper and the chips are sold under short term contract. Hogged fuel is also sold under short term contract and unhogged bark is sold as beauty bark. Shavings are sold for particle board finish.

The primary obstacles to cogeneration are the uncertainity in the lumber industry and the size of the capital investment required. The respondent said that the shape of the lumber industry in the past few years makes it impossible to commit to large capital expenditures.

The mill employs 135 full time and 150 hourly employees, on 2 shifts, year-round. The mill produces about 300 tons of chips and 300,000 board feet of lumber per day. Energy usage and output are anticipated to remain at nearly the same levels as in the past. Brand S plans to shift the start up hours for machinery in order to avoid the demand charge during peak hours. The plant is not intending to make any changes in motors, thinner saw blades or operation techniques.

Wood chips are currently moved through a pneumatic air device. While a conveyor system saves energy, freight costs are increased. Because the conveyor system does not compact as well as the pneumatic system, an extra freight car would be required. The freight charges would be considerable larger than the energy savings.

LOUISIANA PACIFIC

Louisiana Pacific is a moderate size sawmill, employing 75. The wood is dried by a kiln, fired by a steam boiler using sawdust and hogged fuel.

The mill has a chipper, and chips and hogged fuel are sold by contract, written by the Coeur d'Alene office. The primary obstacles to cogeneration are the capital costs and the uncertainty in lumber supply.

Louisiana Pacific bids on forest service timber and only has a one-year contract.

Louisiana Pacific is expecting to increase its electrical load slightly as it is replacing the pneumatic system for moving hogged fuel/ waste product (not wood chips) with a conveyor belt system at a cost of $200 - 300,000. Louisiana Pacific uses thinner sawblades, but is planning no other changes to the plant.

Total connected load for motors is 2000 hp. Specific motor sizes include: 1 - 250 hp; 4 - 125 hp; and many 75, 50 and one-horsepower motors.

ARTHUR MOORE SAWMILL

Arthur Moore produces partially dried lumber using an air-drying process. No kiln drying is done. Wood chips and waste are burned, but cogeneration is too expensive to be considered (as is the use of methanol).

Current plans are to keep the energy per unit of output constant. Plant expansion is being planned. This is expected to reduce costs somewhat, as economics of scale occur.

The respondent felt that the motors used were the most efficient and did not foresee replacing them.

W I FOREST PRODUCTS

W I Forest Products is a large sawmill debarking logs, using a hydraulic technique. Drying is done with a kiln, heated by a steam boiler, fired by sawdust.

W I Forest Products uses a chipper to produce hogged bark and chips which it sells under short-term breakable contracts. The prime impediment to cogeneration is capital expense.

W I Forest Products employs 276 persons, year round and operates 2 shifts. They produce 100 tons of chips and 200,000 board feet of lumber daily.

W I Forest Products anticipates no changes in its electric demand relative to past years' consumption. It is also not considering any changes in plant equipment.

Chips are moved via pneumatic air device. While a conveyor system would save energy, it would increase the freight bill by more than the offset energy savings.

While no motor size distribution was available (it may be possible to obtain this data later), a total load of 3000 hp is on-line.

The respondent stated that there were no incentives to conserve. He added that even though they had conserved in the past, they kept receiving rate hikes.

VINSON TIMBER

Vinson Timber is a small operation with a plant in Montana and a plant in Washington. They were questioned about the operation in Montana. Vinson Timber sells rough cut, air dried, green lumber and employs a friction debarking technique. A kiln installation is planned this summer.

Vinson Timber has a chipper and the chips and hogged fuel are sold under a long term contract. Vinson Timber is currently examining cogeneration but it lacks past experience and management is severely time constrained.

Vinson Timber is expecting to increase both energy consumption and output. The energy increases are a consequence of the recent installation of the chipper and planned installation of the kiln. It is anticipated that sales will increase following installation of the kiln.

Vinson Timber operates year-round, one shift per day with approximately 15 - 25 employees.

CEDA-PINE VENEER

Ceda-Pine Veneer manufactures plywood and uses a mechanical debarking process. The plywood is dried through steam coils, fueled by reclaimed oil. Wood chips and waste bark are produced in the process.

The wood chips are sold under contract and are moved by a pneumatic system. Cogeneration is not considered as a realistic alternative because of the high initial capital costs and the lost opportunity of selling the wood chips.

Ceda-Pine Veneer employs twenty people on a year-round basis. While they would like to expand their output, market conditions are not favorable. Therefore, electric load is perceived to be constant.

APPENDIX B

METHODOLOGY AND SOURCES FOR ESTIMATING ENERGY AND COST SAVINGS FOR CONSERVATION OPTIONS

Appendix B:

METHODOLOGY AND SOURCES FOR ESTIMATING ENERGY AND COST SAVINGS FOR CONVERSION OPTIONS

DEVELOPMENT OF ENERGY CONSERVATION MEASURE COSTS AND ENERGY SAVINGS

Synergic Resources Corporation (SRC) has developed a data base of the characteristics of the major energy using industries in the Pacific Northwest for the Bonneville Power Administration.[1] SRC is currently using this data base to analyze industrial conservation potential in the Pacific Northwest. The data base includes a process flow diagram for the major energy using industries at the 4-digit SIC level, electricity and fuel use by process for a typical plant and the typical plants' annual production, employment, and operating characteristics. Typical plant characteristics were identified by surveying the literature, in-plant surveys and by contacting industry representatives and trade associations.

To assess energy conservation potential in the Pacific Northwest, Waterland Vair Associates (WVA), an industrial energy consulting firm, developed, based on their experience in performing industrial audits and energy conservation studies, a data base of energy conservation measures for several of the typical plants mentioned previously. In essence, WVA performed an energy audit of typical plants to identify technically feasible conservation measures and the costs and energy savings associated with these measures. It should be noted that the typical plants in the industrial data base are not actual establishments but are representative of specific industries.

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1. Synergic Resources Corporation, Pacific Northwest Industrial Energy Use Database, Bala-Cynwyd, PA, July 1981.

The industrial data base and the energy conservation data base were used to identify technically feasible conservation options applicable to the lumber and wood products industry in Montana and to estimate conservation option costs and energy savings.

Development of Electricity Use Distributions By Process

Two 4-digit SIC industries in the lumber and wood products industry which are relevant to this study are included in the industrial data base prepared for the Bonneville Power Administration, namely SIC 2421, sawmills and planing mills, and SIC 2436, softwood, plywood and veneer plants. Process diagrams for these industries are shown as Figure II-1 and Figure II-2 of the final report. The distribution of annual electricity use by process for these two industries is shown in Table B-1 below.

Table B-1:

ELECTRICITY DISTRIBUTION BY PROCESS

SIC 2421 SAWMILLS & PLANING MILLS		SIC 2436 SOFTWOOD PLYWOOD & VENEER PLANTS	
Process[1]	Percent of Annual Plant Electricity Use	Process[2]	Percent of Annual Plant Electricity Use
1-Washing	5.2	1-Sizing, Debarking, Storage	9.4
2-Debarking	8.8	2-Steam Vault	0.0
3-Sawing	21.7	3-Peeling	21.9
4-Edging	8.8	4-Veneer Dryer	3.8
5-Trimming	10.4	5-Sort, Lay, Glue	3.1
6-Chipping	13.0	6-Hot Press	7.5
7-Drying	0.0	7-Trim, Sand	18.8
8-Planing	21.7	8-Finish	32.4
9-Final Trimming	10.4	9-Storage, Shipping	3.1
	100.0		100.0

1. Process numbers correspond to Figure II-1.
2. Process numbers correspond to Figure II-2.

The survey of Montana lumber and wood products establishments performed for this study identifies four types of plants, namely sawmills, planing mills, post and log mills, and veneer plants. The information shown in Table B-1 was used to develop estimates of the processes used in the Montana plants and the distribution of electricity use by process. These estimates are shown in Table B-2. The information in Table B-2 was used to estimate potential energy savings for several conservation options.

Estimation of Conservation Option Energy Savings

WVA prepared a list of conservation options and associated energy savings for several of the typical plants included in the industrial data base prepared for the Bonneville Power Authority. Of the several plant evaluations prepared by WVA, the ones representing SIC 2436 (softwood, plywood and veneer plants) and SIC 2621 (integrated pulp and paper mills) were used in this study. To use information for a paper mill and a complete plywood plant to estimate conservation option energy savings for sawmills, planing mills, post and log mills, and veneer plants it was assumed that like operations in different industries (e.g. debarking in a paper mill and a sawmill) have the same characteristics.

The development of the energy savings associated with the conservation options identified as being technically feasible for Montana plants are discussed separately for each option.

• Conversion of a Hydraulic Barking System to a Friction Barking System

WVA estimated that this conservation option could reduce electric energy used for barking in a paper mill by 20 percent. Referring to Table B-2 and Table B-1, it can be seen that sawmills, post and log mills, and veneer plants may have debarking operations. The percent of annual electricity use which could be saved by applying this conservation option to sawmills, post and log mills, and veneer plants that have hydraulic

Table B-2:

PROCESSES USED IN MONTANA LUMBER AND WOOD PRODUCTS PLANTS AND THE DISTRIBUTION OF ELECTRICITY USE BY PROCESS

SAWMILLS		PLANING MILLS		POST & LOG MILLS		VENEER PLANTS	
Process[1]	% of Annual Electricity Use	Process[1]	% of Annual Electricity Use	Process[1]	% of Annual Electricity Use	Process[2]	% of Annual Electricity Use
1	5.2	8	67.6	1	14.6	1	24.6
2	8.8	9	32.4	2	24.6	2	0.0
3	21.7			3	60.8	3	57.4
4	8.8					4	9.8
5	10.4					9	8.2
6	13.0						
7	0.0						
8	21.7						
9	10.4						

1. Process numbers correspond to those for sawmills and planing mills in Table B-1.
2. Process numbers correspond to those for plywood plants in Table B-1.

debarking systems was estimated by multiplying the percent of plant annual electricity use for debarking (refer to Table B-2) by 0.2. The results are presented in Chapter III.

- Sander Abrasive Replacement and Saw and Knife Honing or Replacement

WVA conservatively estimated that a 10 percent increase in this maintenance item in a plywood plant would reduce energy use by sanders, saws and cutters by 2.5 percent. It was assumed that this savings could be achieved in any type of lumber and wood products plant that uses sawing, sanding and cutting operations. The processes that utilize these operations in different plant types are as follows:

Sawmills	Planing Mills	Post and Log Mills	Veneer Plants
3, 4, 5, 8, 9	8, 9	3	3

The process numbers correspond to those in Tables B-1 and B-2. The percent of annual electricity use saved as reported in Chapter III was calculated by multiplying the percent of annual electricity use accounted for sawing, sanding and cutting operations by 0.025.

- Electric Motor Power Factor

WVA estimated that the application of electronic power factor controllers to selected motors in a plywood plant could reduce plant annual electricity use by 15 percent. It was assumed that this savings factor was generally applicable to all types of lumber and wood products establishments.

- Cogeneration

As explained in Chapter III, the extent to which cogeneration can reduce purchases of electricity is limited by the ratio of steam to electric demand and the availability of an inexpensive fuel, such as wood waste. The survey of plants conducted as part of the development

of the industrial data base for the Bonneville Power Authority identified several establishments in the lumber and wood products industry that utilize cogeneration. The percent of annual electricity use cogenerated ranged from 5 percent to 47 percent. For the present study, it was assumed that establishments in the lumber and wood products industry in Montana having operations suitable for cogeneration could, on the average, produce 30 percent of their total annual electricity used in this manner.

- Installation of High Efficiency Lights

WVA estimated that lighting accounted for 4 percent of the annual electricity used by a plywood plant. It was assumed that this estimate was generally applicable to all plants in the lumber and wood products industry. WVA also estimated that electricity used for lighting could be decreased by one-third by replacing existing lights with high efficiency units. On an annual basis this represents a savings of 1.33 percent (i.e., 4 percent x 0.33).

- Institute a Strict Control Program to Shut Off Unneeded Lights and Equipment

Energy savings possible with this conservation option is plant specific, and even for a given plant is difficult to quantify. WVA, based on their experience in conducting industrial energy audits estimated that this conservation option could reduce annual electricity use in a typical plywood plant by 1.6 percent. It was assumed this percent savings was applicable to all establishments in the lumber and wood products industry.

Estimation of Conservation Option Costs

WVA prepared estimates of cost and of reduction in electric demand, as well as energy savings estimates, for a number of conservation options applicable to establishments in the lumber and wood products industry. These estimates were prepared for typical establishments for which annual production, annual operating hours, number of employees,

etc. were specified. Therefore it was necessary to normalize the WVA cost estimates so that they could be used in this study. Reduction in electric demand was used as a normalizing factor. That is, the estimated installed cost for a specific conservation option was divided by the estimated reduction in electric demand (kw). For example, WVA estimated that the cost for converting a hydraulic debarking system to a friction debarking system in an integrated paper plant producing 300,000 tons of paper per year would cost $600,000 and would reduce the electric demand by 692 kw. Therefore, the normalized cost would be $867.05 per kw of electric demand reduction. Since this plant was assumed to operate 8760 hours per year, the cost per kwh saved in the first year would be $867.05/8760 or $0.099/kwh as reported in Chapter III. This approach was used to develop the other cost values reported in Chapter III.

OPERATION AND MAINTENANCE ESTIMATES

Operation and maintenance (O&M) costs were estimated as a fraction of installed cost. Experience has shown that annual O&M costs are typically in the range of 1 to 5 percent of the installed cost for a wide variety of systems. For more complete systems, annual O&M costs as a percent of installed cost will tend to approach the higher end of this range.

Typical operation and maintenance items include adjustments, calibration, cleaning, lubrication, repair and/or replacement of defective parts, monitoring, periodic overalls of inspection, etc. The O&M cost estimates include both labor and materials.